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BIOLOGICAL TREATMENT OF HIGHLY ALKALINE TEXTILE MILL WASTE - SEWAGE MIXTURE

Progress Report of the Industrial Waste Section of the Sanitary Engineering Research Committee of the Sanitary Engineering Division

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THIS PAPER

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SED RESEARCH REPORT NO 1

ON	BIOLOGICAL TREATMENT OF HIGHLY ALKALINE TEXTILE MILL WASTE - SEWAGE MIXTURE
BY	The Sanitary Engineering Research Committee Industrial Waste Section.
From Research Data of	R. H. Souther, Research Director, and T. A. Alspaugh, Chemist, Cone Mills Corporation, Greensboro, N. C.
Acknowledgment:	The Sanitary Engineering Division gratefully recognizes the generosity and professional courtesy of the authors in making these research data available to the Society for review, presentation and comment by the Industrial Waste Section of the Research Committee.

Synopsis: The results of a research project on biological treatment of highly alkaline textile mill waste-sewage mixture are presented in summarized form, critically discussed, and evaluated constructively with a view towards engineering application.

INTRODUCTION

The effective treatment and disposal of highly alkaline, pollutional sewage—waste mixtures has become a thorn in the side of municipal and industrial sanitary engineers. These wastes usually contain a high quantity of dissolved organic matter having a correspondingly high oxygen demand. The only practical means of reducing the BOD, when it results from dissolved organic matter, is to decompose it biologically. An exception exists when the solids content is high enough to warrant evaporation as in the disposal of kraft pulp digester liquor. It has been an accepted tradition among waste treatment engineers not to consider biological treatment of a waste with a pH over 9.0 unless with a preliminary neutralization. The addition of acid to lower the pH to this level sometimes results in excessive daily operating costs. In the researchers' plant the acidification with sulfuric acid alone would amount to a daily cost of almost $1,000. At present there are two methods being studied to eliminate or reduce the operating expense of neutralization.

1) Flue gas treatment.
2) Development of a highly resistant bacterial flora which can be adapted to the high pH environment.

The first method is receiving considerable attention by several

researchers in the textile waste field and will be the subject of a future discussion by the Research Committee. The second method was used by the authors even though the literature is replete with discouraging results at elevated pH values.

Pilot Plant

Wastes	approximate % by volume
Kier and finishing waste, vats, sulfur, indigo, color shop, and mercerizing wastes	69
Rayon and cotton finishing waste	12
Rayon and cotton dye waste	11
Sulfur and indigo	5
Bleachery and kier	3

The textile mill waste was added to replace sewage in increasing percentages. It was started on 4% waste and 96% sewage. This was continued, gradually adding more of the textile mill waste and decreasing the amount of sewage until the ratio of 40% mill waste and 60% sewage was reached.

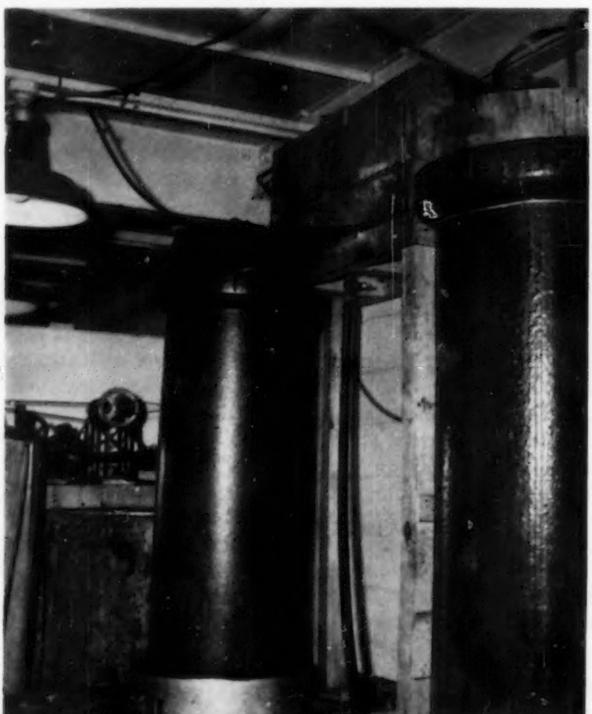

Figure 1

The authors applied the waste-sewage mixture on an experimental filter having a volume of 4.88 cubic feet and a surface area of 1.22 square feet. The loading of 471 ppm BOD on 4.88 cubic feet of filter at a rate of 125 gallons per day was 101 pounds per 1000 cubic feet or 2.73 pounds per cubic yard. The filter stone size was 1-1/2 to 3-1/2".

Results

Laboratory pilot plant trickling filter experiments showed that the highest practical pH was 10.5. The following table summarizes the results at this pH when using a 2:1 recirculation rate over a one month period.

	Initial	Effluent	Final Settling Basin Effluent
BOD (ppm)	471	230	198
Color (ppm)	600	345	335
pH	10.5	9.1	9.1

Discussion

It has been generally accepted that the efficiency of a filter will decrease as the BOD loading is increased after a certain maximum level. The level has arbitrarily been set at 1.5 to 2.0 pounds per cubic yard. Therefore, the loading used by the authors was approximately twice that accepted as a safe design for maximum efficiency. Souther and Alspaugh obtained 58% BOD reduction after the filter effluent was settled. When the high load and the high pH are both considered, a reduction of 58% is very encouraging. It is quite possible that greater than 60% BOD reduction could have been obtained if lower loadings had been used.

The reduction in pH from 10.5 to 9.1 in the plant is quite significant because it indicates biological activity. However, the total alkalinity of the waste mixture as it went through the pilot plant remained about the same, but the hydroxides and carbonates are gradually converted to bicarbonates. This action could have been partly due to absorption of CO_2 from the atmosphere. The lowered pH of the filter effluent is desirable for at least two reasons:

1) Less neutralization before ultimate disposal is required.
2) A greater efficiency of a secondary biological treatment unit will be obtained.

The color reduction from 600 ppm to 345 ppm (42.5%) is significant because it is usually desirable to reduce the color of sewage-waste mixtures to a degree where it will not be too noticable in the receiving water. The reduction of colored matter could have been associated with the removal of BOD. Apparently no colored matter was made insoluble by the passage through the filter because no further reduction in color was obtained in the settling basin. In this respect the BOD reduction differed from the color removal in that an additional 6.7% BOD removal (based on original 471 ppm) was obtained in the settling basin.

It might be predicted that the use of the relatively small stone sizes which the pilot plant filter contained would lead to an early clogging especially at the high organic loading. No clogging was encountered in the pilot plant, however.

CONCLUSIONS

1) A highly alkaline textile waste-sewage mixture has been successfully treated without neutralization on a high-rate trickling filter.
2) At a pH of 10.5 and a BOD loading of 100 pounds per 1000 cubic feet per day a 58% reduction in BOD was obtained with filtration and settling.
3) The pH was reduced from 10.5 to 9.1 by the filter.
4) A color reduction of 42.5% was effected by passage of the sewage waste mixture through the filter.

Engineering Implications

These research results indicate that it may be entirely feasible to treat biologically a highly alkaline sewage-waste mixture without prior neutralization. This should result in somewhat lower efficiencies but also in a considerable savings to the municipalities and industries. The reduced pH of the filter effluent will make for a higher degree of efficiency in any subsequent biological treatment unit. Therefore, the trickling filter can be used to advantage as a "roughing" or preliminary biological treatment. The 42.5% color removal is a welcome secondary results of the filter operation. It is becoming increasingly imperative that municipal treatment plants remove color as well as BOD from the sewage. The public is demanding that waste effluents should be "out of sight" as well as non-pollutional.

Credit: This research report, which is one of a series of professional contributions by the Committee on Sanitary Engineering Research,

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c. Discussion of several papers, grouped by Divisions.

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